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USSR Report

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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USSR REPORT

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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INFORMATICS INDUSTRY: PROBLEMS, NEED FOR CENTRALIZED CONTROL

Moscow EKONOMICHESKAYA GAZETA in Russian, No 2, Jan 86 p 9

[Article by Yu. Kanygin, Doctor of Economic Sciences, Professor, Manager of the Computerized Informatics Laboratories of the Ukrainian SSR Academy of Sciences, Cybernetics Institute imeni B. M. Glushkov, "Concerns to the Informatics Industry"]

[Text] In recent years the USSR Academy of Sciences and the GKNT clearly designated the main directions of the influence of the information industry on the development of the national economy.

First, there is computerization of work tools, their "animation" by means of either built-in microcontrols and microprocessors or the connection of production aggregates to large controlling computers. Creation and application of manipulators and robots plays a special role here.

Second, computerization of production technologies by means of creation of an ASUTP (Automated Control System of Technological Processes). Many prospective technologies in general cannot be created without the use of computer systems.

Third, computerization of social-communicative processes, in other words, automation (as possible) of management, science, education, environmental protection, services, monetary-cash operations, medicine, and even to a certain extent, solution of everyday problems.

The Alpha and Omega of such automation are microcomputers, the instrument-making industry, and the entire informatics industry, the importance of which is earnestly emphasized in the June meeting of the Central Committee of the CPSU. It is necessary not only to increase the scale of this industry, but also to raise the technological and organizational level of its functioning.

What is it necessary to do in particular in order that the new industrial technology of information processing would reveal its social usefulness in full measure, not simply becoming an element of daily human practice, but radically transforming it and improving it? It turns out that for the answer to this complex question a special merging of knowledges about all aspects of development, design, creation, and use of human-machine information systems is

necessary. A new field of science appears from this fusion which received the name "Informatics."

The USSR Academy of Sciences created a department of Informatics, Computer technology, and Automation, and within it are a number of scientific institutions. Informatics as an educational discipline is being introduced in schools, VUZes, and technical schools. It is important that at the center of attention are placed the so-called user aspects of hardwear, methods of definition, and the increase of the useful output of computers.

With Informatics will undoubtedly be connected the final victory over narrow technicism in the use of the computer, when computers were often planted in unprepared or insufficiently-prepared organizational-economic and human environments, producing obviously low output of computer technology.

At the beginning of the current year, as it is known, a unified State program was accepted for creation, development of production, and utilization of computer hardware and automated systems. To it are linked questions of creation of electronic hardware, including computers of fourth and fifth generation and application of them within the framework of various systems, primarily organizational-informational. Earlier many programs operated in which, basically, development problems were presented fairly separately. The real prerequisites for further technological formation and organizational design of the Informatics industry as an independent sector of the National Economy, have now appeared.

In recent years definite strides were made in improving the organization of the Informatics industry and improving the economic mechanism of computer centers, imparting to them a modern industrial appearance. So the Central Statistical Administration of the USSR in its list of sectors of the national economy has especially distinguished the sector of the computer-information industry.

Informatics is today being transformed into a major multi-sectored industrial complex. It includes the basic and support enterprises and organizations for processing and transmission of data -- computer centers and information computer centers of various classes and purposes, funds of algorithms and programs, other subdivisions which develop porgrams, data transmission networks, organizations which service computer centers. The growing computer-information "nerve network" of society requires unified technical policies, unified structures and regulations, and centralized management.

It is thought that the time has come to decide the question of forming, within the limits of the Informatics industry, a special subsector -- for production of software products. It is necessary to qualitatively improve software engineering, raise labor productivity of programmers by orders of magnitude, and relatively (on a per computer basis) reduce their numbers. Then it will be possible to reduce sharply the cost of a single software product.

But, in order to solve such problems it is necessary, as far as possible, to take programming beyond the limit of separate, weak computer centers, to concentrate it on strong specialized organizations of industrial type. Of course here sharply arise questions of "ties" of software to conditions of specific enterprises and user--organizations.

A sector of Informatics should include enterprises for technical service of computer centers, and also a network of research and design-construction institutes, and SKB (Special Design Bureau), which develop standard designs and models of automated systems. Within the framework of separate departments much has been done for the organization of similar subdivisions. An All-Union Association and its regional departments has also been created for engineering service of computer centers, and development of complete software-hardware complexes. However, for now all this does not meet the department standards of Informatics.

Many computer centers are still not covered by centralized engineering service. Input of computer hardware often misses planned deadlines. Personnel who service hardware as a rule know the specifics of basic products poorly, and manager-production workers in their turn do not possess the necessary skills for utilization of the results of computer processing of information.

Problems are many. But there is, in my opinion, that link which, if grasped, could, as they say, extract the entire chain. This is improvement of management by computer-information potential, its growth, and utilization.

It is necessary to directly state: we use advantages in organization of the application of computers and automated systems inadequately. The rapidly growing Informatics industry, unlike other sectors, is still developing -- incompletely, without a unified plan, without centralized management.

With obvious and acute need for a unified hardware policy, expensive computer information resources are scattered among many sectors. Is it possible that even the forming government network computer center will be "distributed" among industrial ministries and departments? How then will it be unified and national?

A whole number of departments (Gosplan USSR, Goskomitet USSR for science and technology, TsSU USSR, and others), and even several ministries, chief producers of electronic hardware (Minprobor, Minradioprom, and Minelektronprom) carry out planning, management and organization of developments, production and utilization of computer hardware and general purpose systems. At the same time the organization is absent which could wholly take upon itself the responsibility for the realization of a State program for computerization.

Questions of reorganization of management by the computer potential of the country in close connection with the solution of problems of modernization of planning and management of the national economy, and increasing the effectiveness of the ASU, were brought up in the article featured in "Ekonomicheskaya Gazeta" No. 52, 1980. Now they have come up especially acutely in connection with the aims put forth by the Party of intensification of economics, and radical acceleration of science and technology progress.

It is advisable organizationally to divide the country's information-computer resources (hardware, networks, communications, software, etc.) into categories: national and departmental.

To be sure, the structures and functions of agencies of centralized control by computer-information resources, and the forms of their interaction with other State agencies -- all this must be made more exact and debuzzed. I would like only to stress the main point: the basic reserves for increasing the effectiveness of the entire Informatics industry will be found in the creation of a more modern organizational base for carrying out all the work for computerization of the national economy.

13093/12955
CSO: 1863/132

USSR(HOME) MOSCOW FIRST

Moscow BROADCAST on 1100 GMT 4 Feb 86

[Abstract] Academician Boris Nikolayevich Naumov describes the work of his institute, the Academy of Sciences Informatics Problems Institute: within the wide sphere of information sciences, the Informatics Problems Institute researches problems relating to machines in mass use, including the so-called personal computers. An inter-industrial scientific and technical complex has been set up based on the institute to head research into mass development and application of personal computers in various spheres of the national economy. These spheres are, chiefly: automation of design and planning, especially in construction, where automation has hardly penetrated; automation of technological processes; automation of scientific research and experiments, and economic calculations. Local networks have now been developed based on optical fiber lines, which allow all these small automated workstations to be linked. The institute is also engaged in developing programs and software packages for these areas. A very large number of government departments are involved in developing and manufacturing personal computers: in addition to the main departments manufacturing machines, about 30 ministries are involved in one way or another in the development of computer technology; somewhat fewer are involved in personal computers. It is clearly inefficient for each department to turn out unique models in small numbers: reliability is low, costs high. What we are striving for is low cost to ensure mass use, somewhere around a few hundred roubles, though there should of course be a whole family of computers of varying sizes and costs, depending upon the tasks to be resolved. The inter-industrial scientific and technical complex will comprise the Institute, the correspondent suggests, and presumably a factory. Naumov admits that this is the weak point of the project so far: the complex would operate well if it were to have a good experimental works, well-equipped with modern means of design automation and a design and planning department. "Unfortunately, though we have made little progress in regard to the design and planning department, we have had no success in the initial stage of resolving the matter of production. But I hope that this matter will be examined in the very near future and that we shall be allocated such a works. We would like this works to be equipped in such a way as to enable it to transfer easily to production of various classes of machines and various generations of machines. In this event, there will be some sense in having such a complex. If no production is involved, if there is no works - our sphere is an applied sphere, which means that of course the projected effect will not be obtained."

Asked about co-operation with other socialist countries in the sphere of compute technology, Naumov says that a certain degree of experience has already been gained in developing unified systems and micros. The recent scientific and technical conference of the CEMA countries demanded developments and methods to proceed at quite a different rate. Co-operation with socialist countries will make progress in automation and introduction of electronic technology far easier.

/12955

BRIEFS

NEW CONTROL PANEL--The first multi-purpose control panel in the Baltic republics has begun operation in the territorial management of the water supply and sewer system of the Lithuanian city of Panevezhis. The automated system will control water purification, the work of artesian wells, and water consumption in residential microdistricts and industrial enterprises. The operational reliability of water mains will also be significantly increased. In the event of even the most insignificant water leakage or breakdown, automatic mechanisms convey an alarm signal to the panel in a matter of seconds, where the controller can cut off the damaged parts of the network with the push of a button. "The capabilities of the new panel," says chief managing engineer Romual'das Tishkyavichus, "are designed in accordance with the long-term development of our economy through the year 2000." According to preliminary data, automation will allow savings of more than 2.2 million cubic meters of water per year. [Text] [Moscow IZVESTIYA in Russian 10 Nov 85 p 2] 13017/12955

NEW COMPUTER SYSTEMS--The collective of the Severo donets scientific-industrial association "Impul's" is actively preparing for series production of new computer systems. Six types will be produced in the twelfth five-year plan. Along with this, norms for the use of ferrous metals have been lowered 19 per cent, of non-ferrous metals by 15 per cent, and of electrical energy by 12 per cent. The collective gives great significance to questions of modernizing the computing equipment it produces. In 1986-1990 no less than 75 per cent of its basic line will be renovated with a simultaneous increase in total production of 83.2 per cent. The cycle of putting multi-machine complexes into operation will be cut in half. ["Two Times Faster"] [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 41, Oct 85 p 9] 13017/12955

CONFERENCE ON COMPUTERS AND EDUCATION--"Automated Systems of Education Based on the Computer"--this is the theme of the Soviet-French seminar which began October 23 in Tashkent. It is taking place at the most extensive VUZ in Central Asia--the Tashkent Polytechnical Institute imeni Beruna, where rich experience in atuomating educational processes has been accumulated. Specialists from the two countries are exchanging their experience in using computers for raising the effectiveness of education, and will set out paths towards the creation of new systems for training specialists with the computer. ["Russian-French Seminar"] [Text] [Tashkent PRAVDA VOSTOKA in Russian 24 Oct 85 p 2] 13017/12955

NEW COMPUTERS GO INTO OPERATION--A new ES-1045 computer has gone into operation in the computer center of the industrial association "Ch.T.Z. [Chelyabinck Tractor Factory] imeni V. I. Lenin." [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian 8 Jun 85 p 2] A new M-5100 computer is being set up in the information-computing center of Rakvereskiy Rayon. Installers from Leningrad arrived to aid local specialists. The computer is a new modification of a series of machines which are already at work in the center. Its advent will allow an increase in work volume, and will better serve the enterprises. [Article "New Computer" by V. Karu] [Text] [Tallinin SOVETSKAYA ESTONIYA in Russian 8 Jun 85 p 2] 13017/12955

COMPUTERS ASSIST PHYSICS RESEARCHERS--[The following passage captions a photograph which recently appeared in SOVETSKAYA LATVIYA]. The collective of Leningrad State University's Laboratory of Structural Research of the Scientific Research Institute on the Physics of Solids imeni P. Stuchka is making a great contribution to the development of science. In the photo, our photojournalist has captured a working moment in preparation for processing data from an experiment on electron diffraction, in which the head of the Department of Semiconductor Materials, A. Lunis, and his junior scientific colleague G. Ramans are participating. The information derived is important not only in the plane of basic research, but also for purely applied purposes. [Text] [Riga SOVETSKAYA LATVIYA in Russian 1 Dec 85 p 2] 13017/12955

COMPUTER JOURNAL BEGINS PUBLICATION--In recent years, the computer has come to the aid of traditional means of processing the ever growing stream of information. "The home computer," asserts one of the foreign experts on organizational technology, Earl Joseph, "will store published press reports in its memory and reproduce them according to your selection on the screen. You may even program it so that it will draw your attention to all the reports on a certain subject." Moreover, the well known Soviet authority in the field of information, Professor A. I. Mikhaylov, thinks that "information is beginning to be created not at the desk, but at the terminal. To get essential information, specialists turn more and more often not to a book, but to automated information systems." In a word, the computer is capable of being helpful in a great many areas. But it is also necessary to assist it and its introduction. The new journal MICROPROCESSING EQUIPMENT AND SYSTEMS, which the USSR State Committee on Science and Technology has begun publishing, is dedicated to doing this. The first issue of the journal suggests the most rational ways of using microprocessing and microelectronic technology. First of all, it suggests means of using our first home computer--the "Agat"--which is small and simple as computers go, and allows one to carry out a great mamy useful and difficult tasks. It also points out ways of employing computers in schools, where computer classes are being created for solving problems in the educational process. It seems that the quarterly journal MICROPROCESSING EQUIPMENT AND SYSTEMS will become a popular publication. It is not only our demand for computers, which is becoming habitual, that argues for this, but also the fact that the journal THE COMPUTER FOR YOU, which was recently founded in Bulgaria, aroused great interest immediately. At least, I dug up an issue only with difficulty, although I visited all the kiosks in Sofia. Without undertaking to compare two related publications, I will only point out: our Bulgarian colleagues have

found a more attractive title for their journal... [Article by K. Barykin] [Text] [Moscow ZHURNALIST in Russian No 8, Aug 85, p 27] [COPYRIGHT: Izdatelstvo "Pravda", "Zhurnalist", 1985] 13017/12955

L VOV COMPUTER CENTER ESTABLISHED--A collective-use computer center has been established in L vov. It will make it possible to solve a wide range of production and economic problems. It began processing information today for all the region's major enterprises, which will now have no need to buy and maintain their own costly equipment. [Text] [Moscow DOMESTIC SERVICE in Russian 9 Dec 85] 13017/12955

CSO: 1863/103

A NEW WAY OF HOLOGRAPHIC RECORDING OF INFORMATION

Moscow PRIRODA in Russian No 12, Dec 85 p 104

[Text] A. A. Vasilyev, P. V. Vashurin, V. A. Yelkhov, I. N. Kompanyets, A. V. Prafenov, and P. M. Semochkin (Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences [FIAN]) developed a new system of holographic paged recording of information. Such a system is characterized by a higher recording density and protection from interference. Basically, these advantages become apparent with the recording of large files of information -- pages of text, sketches, and pictures. The output of such files is highly effective with the help of space-time light modulators, from which liquid-crystal models obtained the greatest diffusion.

Up to now in the majority of systems being used for recording of holograms, a modulator of light bunch amplitude has been used. The most information can be stored in the case where uniformity of characteristics of the modulator all across the aperature area is obtained; it is for this reason that the requirements for quality are so high for manufacture of the modulator. For example, in order, in the modulator, which uses the controlled two-beam refraction in a liquid-crystal, to sustain a contrast of a picture 10:1 across the entire area, the thickness of the liquid-crystal layer should not change by more than 0.2 microns (for the wave-length of light, 0.63 microns. Since this size usually amounts to 1 micron on a 1 cm^2 area, then similarly the area of the hologram cannot exceed 0.2 cm^2 (that is less than 5 X 5 mm). As a result, even the capacity of information files is limited.

The FIAN-developed method of recording of holograms is characterized both by a heightened contrast of a picture, and by considerable reduction of requirements of uniformity of the thickness of the liquid-crystal layer. This is connected to the fact that in it is used phased bunch modulation, which (in contrast to amplitude) is much less sensitive to the nonuniform thickness of liquid-crystal. Using a modulator 20 X 20 mm in area with a nonuniform thickness 1 - 2 microns it manages to obtain a contrast of 30:1. [Kvantovaya Elektronika, 1984, v. 11, No. 2, pp 403-405]

13093/12955

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SOVIET 5TH GENERATION COMPUTER

Leningrad TASS 22 Jan 86

[Text] Electronic micro-circuits with an unprecedently high-density packaging of up to ten million integrated components per square centimeter will be the main part of the "brain" of a new Soviet computer.

Work to develop this 5th-generation machine has begun at a scientific-and-technological association of the Academy of Sciences of the USSR in Leningrad.

"The task in effect is to devise fundamentally new technology for engineering and assembly at atom level," explains the association's director Maxim Alexandrov, a well-known Soviet expert in scientific instrument-making. "We hope the computer will be able to do up to ten billion operations a second."

The super-computer will also be capable of both simultaneous and parallel data processing and, most important, it will be able to perceive both visual and sound patterns. Man will be able to communicate with it in speech. Work is already under way to compile vocabularies for this kind of intercourse.

Alexandrov says the main difficulty in developing the new computer is connected with the search for "thinking atoms", new materials for integrated components capable of very fast action. The association is now developing unique equipment for a super-accurate analysis of the structure and substance of the future integrated component base.

"The development of the new-generation computer involves a collossal amount of technical and technological tasks," the scientist says. "In my opinion, these tasks should be tackled through pooling the scientific and technological potentials of several countries." He recalled that the issue of joint work on a 5th-generation artificial-intelligence computer was discussed at the 41st special sitting of the session of the council for mutual economic assistance last December in Moscow.

Alexandrov says the real time when the creation of the "intellectual machines" can be expected is the early 1990s.

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DISCOVERY IN LOW-TEMPERATURE PHYSICS

Moscow TASS 14 Jan 86

[Dispatch by TASS Correspondent Ivan Ivanov]

[Text] Twenty-first-century computers will be far more capacious than today's because they will use materials cooled to temperatures close to absolute zero, our TASS correspondent has been told by Dr Yuri Bunkov, one of the makers of a discovery which should provide the basis for the development of such computers.

Staff members of the USSR Academy of Sciences Institute of Physical Problems are studying the properties of the helium-3 isotope, liquefied and cooled to a mere 0.0004 degree kelvin. An apparatus developed at the institute for the purpose makes it possible to obtain temperatures below that in outer space.

According to Bunkov, at temperatures close to absolute zero the molecules stop moving chaotically and acquire remarkable properties: some metals become superconductive, while liquid helium becomes superfluid, that is it virtually loses viscosity.

Liquid helium- isotope is placed in a honeycomb-like cell with a volume of a few cubic centimeters in the very heart of the apparatus. Scientists have found out that the excitation of superliquid helium with an electromagnetic pulse causes a unique effect in the cell: part of the liquid acquires magnetic properties while the rest loses them, which means transfer of magnetism. Bunkov believes that given such unusual properties under temperatures close to absolute zero, helium-3 isotope can be used in new computers to improve their capacity and to make them faster.

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UDC 621:65.011.56

THE DATA INPUT UNIT IN ASUTP

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 11, Nov 85 pp 26-27

[Article by G. I. Bondar, S. I. Chebanenko, R. Kh. Khabibullin, and Physics-Mathematics Candidate M. Kh. Brenerman]

[Text] One of the most important conditions for normal functioning of ASUTP [Automated Control System for Technological Processes] is the timely input of data from work areas into the control computer complex (UVK), which may conventionally be separated into two flows. The first is formed from data on the state of transmitters positioned on production equipment, and arrives at the UVK automatically, without direct human participation. The second flow contains data of a directive or reference nature (data on chemical analysis, availability of resources, control decisions, normative-reference information) and is formed manually by dispatchers and operators.

The basic technical agents for the second flow, the character displays and information registration consoles, form part of the data collection and transmission complex (KSPD) and are awkward adn expensive units. Certain conditions (permissible temperature and moisture values and dust levels of the room, absence of vibration, etc.) are necessary for their operation, which often makes their placement directly on the operators' work areas impossible.

The use of a work area console (PRM) is more expedient. The console is intended for the input of data on the course of a technological process and processing of inquiries, and also for the output of control directives from the UVK to the work area.

The PRM in the composition of ASUTP accomplishes input-output in the UVK using numerical and character (letters U, E, S, R, N, P) data with simultaneous representation on the indicator panel.

The exchange of data between the PRM and the UVK is realized through a four-wire line connection of five frequencies (the frequency is determined by the placement of the corresponding strap on the PRM board depending on the distance between the PRM and the UVK): 50, 25, 12.5, 6.25 and 3.125 kHz.

The number of simultaneously transmitted digits is four, which allows for every combination of digits and characters.

The levels of exchangable signals are : logical 0 - from 0 to 4 V; logical 1 - from 20 to 28 V. The maximum distance of the PRM from the UVK is 1 km.

The PRM sets power from an alternating current network of frequency 50 $\pm$ 1 Hz and voltage 220 V $^{+10\%}_{-15\%}$. Power consumption is no more than 25 Vt. Dimensions are 300 x 250 x 210 mm. Mass is no greater than 7 kg.

Communication of the PRM with the UVK is realized with standard moduli of discrete data input-output from the nomenclature of SM EVM [Softward Systems for the Computer]:

the module of input of initiative signals (MVvIS) A622-8;

the module of input of pulse-coded signals (MVvCIS) A632-2;

the module of output of impulse signals (MVImS) A641-10.

For each of the moduli the PRM uses one part.

In this way, up to 60 consoles may be connected by using one MVvIS module, four MVvIS module, four MVvCIS modules and one MVImS module connected to a control computer of type SM-1, SM-2, SM-2M, or SM-4 (through the interface matcher OSH-2K).

High reliability of transmitted data is ensured by a hardware-software control system.

The PRM may operate in a medium of current-conducting dust, displays high noise-protection and vibration resistance, and has a small size and mass which makes its placement in practically any chemical and metallurgical production work area possible. In addition, the PRM possesses a rather large data capacity: with a single data transmittal (one stroke of the "Input" button), one of 65,536 messages may be transmitted. This makes it possible to use not only in ASUTP, but also in certain ASUPs [Automated Enterprise Control System].

The console has the form of a self-contained desk-top and suspension enclosure unit, and has a pressurized body, keyboard, and four-digit indicator panel. The general appearance of the unit is shown in the drawing. The component base of the PRM is microcircuits of the series K155.

The algorithm of the exchange of PRM with control computer (UVK) includes data input and output procedures. The first controls the input of alphanumerical data into the main memory from the keyboard of the console. The second controls the output of directive and reference data and its representation on the PRM board.

Both procedures contain blocks for controlling the validity of data transmission.

Input Procedure - After selection of data (the "PRM" lamp lights up) and a stroke of the "Input" button (the "PRM in Use" lamp lights up) into the UVK through MVvIS by the bus "Control PRM", the initiative signal is generated, after the processing of which the UVK generates one impulse through the bus "Control UVK" into PRM through MVImS. The PRM then generates a first digit code onto the bus "Information PRM" to the impulse and again generates an initiative signal. This part of the procedure is repeated four times. After a complete read-out of the content of all four digits and their notation in the buffer of the main memory, the content of the buffer is transmitted back to the PRM through the bus "Control UVK" for schematic control coincidence. Upon code coincidence, the "PRM" and "PRM in Use" lamps go out, and the "End of Operation" lamp lights up.

When transmitted and received data do not coincide, the PRM adjusts the initiative signal and the input procedure is repeated until the codes coincide (but no more than three times). For a triple noncoincidence the exchange stops and the "End of Operation" and "Error" lamps light up.

Output Procedure - Data exchange is carried out analogously, but in reverse order. The difference is that the data generated from the UVK is transmitted to the UVK for program coincidence control. When codes coincide, in order for the procedure to be completed from the UVK through the bus "Control UVK", 8 to 15 impulses are generated, after which the "End of Operation" lights up on the PRM, and the data transmitted from the UVK is illuminated on the indicator panel. When codes do not coincide, 1 to 7 impulses are generated in the PRM, and the "End of Operation" and "Error" lamps light up.

The transfer programs are realized in the framework of disk operating systems of the aggregated software system for the UVK M-7000, SM-1, SM-2, SM-2M (DOS ASPO, DOS-P ASPO) and formulated as a program library. When they are generated, they may be included in every load module.

The possibility of their functioning in the form of disk-resident segments is also foreseen.

In addition, the exchange programs are compatible with the widely known disk packet of program modules for data collection and processing in ASUTP. Both programs are written in FORTRAN IV, and each of them uses about 0.2K of main memory (two sectors on the IZOT 1370 disk). Since FORTRAN IV is a problem oriented language, the exchange programs are easily adapted for use in the UVK SM-4, as well as all other UVK's where hardware-controlled mating of the interface of a given UVK with a 2K interface is possible.

The PRM described has been introduced in the State Scientific Research and Design Institute for Introduction of Computer Technology into the National Economy (GNIPI-VT, Kazan) and is used as part of debussing complexes of ASUTP.

13183/12955
CSO: 1863/121

SOFTWARE QUALITATIVE EVALUATION REVIEWED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 11, Nov 85 pp 38-40

[Article by Doctor of economic Sciences A. P. Ivanov and Engineer N. F. Simonova: "The Basic Principles of Qualimetry In Evaluating Automated Control System Software"]

[Text] An important and long-term trend in increasing the effectiveness of computer technology use is the development of high quality software. In this regard, the task of developing a single methodological approach to analyzing software quality, developing the theoretical aspects and also resolving such basic issues as evaluating the quality of programs and certifying them is becoming ever more urgent.

At present, all of these issues are being discussed in Soviet and foreign literature and have been worked out to varying degrees. The issues and methods for the evaluation and quality of program sets at various stages in their life cycle (Footnote 1) (V. V. Lipayev: "Kachestvo Programmnogo Obespecheniya [Software Quality], Moscow "Financy i Statistika" 1983, p 263) are being examined and systems for software quality characteristics are being proposed. (Footnote 2) (B. Boehm and others: Kharakteristiki Kachestva Programmnogo Obespecheniya [Characteristics of Software Quality], Moscow. MIR, 1981, p 208) (Footnote 3)(A. F. Kulachkov: Otsenka Kachestva Programm EVM [Evaluating the Quality Of Computer Programs], Kiev: Tekhnika, 1984, p 168).

Relating software to production for industrial and technical purposes has allowed the problem of evaluating their quality to be solved by using principles, approaches and methods developed by qualimetry (Footnote 4)(G. G. Azgaldov: Teoriya i Praktika Otsenki Kachestva Tovarov (Osnovy Kvalimetrii [The Theory and Practice of Evaluating the Quality of Goods (The Foundation of Qualimetry)]). We must note the specificity of evaluating the quality of a software product that has been conditioned by the following features of the product itself and by the processes of its development and use:

the process of developing software has traits that are inherent both in industrial production and in mental work;

software does not really have a material nature:

human labor is most important during software development, but equipment is taking on a constantly increasing role;

there is a high degree of uncertainty of attaining results in a given

time, especially in the early stages of software development;

programs must be constantly modified, corrected and improved during their development and use;

the cost and time for circulating a program is significantly less than then the corresponding cost of its development;

software quickly becomes obsolete.

The basis for and reliability of evaluating software quality depend on to what extent the requirements for its components have been totally defined in the early stages of its development and to what degree the criteria that were selected for evaluating intermediate results were linked to the quality of the final software product. The problem of evaluating software quality is broken down into a number of tasks:

detecting, substantiating and classifying the properties that characterize software quality at various stages of its development;

developing methods for measuring them, i.e. a quantitative evaluation of the intermediate product through several autochthonous, partial indicators;

studying the possibility of developing different partial indicators into a single combined indicator that characterizes the quality of the software as a whole.

Table 1

The Environment	Characteristic Software Qualities								
					Effective Use of Resources				
	reliability	correctness	ability to be modified	mobility	labor res	machine time	memory	documentation	ease of use
Organizational-technological conditions and methods for developing software:									
structured design project and coding	+	+	+	+				+	+
top-down integration	+	+	+	+				+	
TKP [Programmer's Tool Kit	+	+	+	+	+			+	
chief programmer team	+	+			+			+	
Program language									
machine oriented	±	±				+	+		
problem oriented	+	+	+	+	+			+	+
Software standardization and its developmental process	+	+	+	+	+	+	+	+	+
Area for software application									
system software	+	+	+	+	+	+	+	+	+
application software	+	+	±	±	+	±	±	±	±

NOTE: + is a property that is unconditionally attained in program production using the given approach, method and manner; ± is a property that depends on the specific conditions of software application.

Software, just as any other product used for industrial-technical purposes, has a number of diverse properties. However, a program can satisy different requirements thanks to defined properties which are established during the process of developing the program and which are manifested during its use. Various techniques, methods and mediums that are used at the various stages of program development effect the development of certain properties in these programs (Table 1) and during operational use, only those properties which are defined by the requirements of operating conditions are manifested. For example, the use of a structured approach in the developmental process develops program properties that increase their reliability, ability to be modified, mobility and ease of use. This is achieved by standardizing the methods for writing programs, organizating them into small modules and configuring program logic so that it can be read from top to bottom (this is impossible in the traditional approach).

The introduction of progressive technology and modern methods for organizing work, and specifically the work of the chief programmed team, is significantly increasing: the reliability of the software being developed; their documentation through developer specialty; the establishment of efficient links between them and the structural control of the programs. At the same time software properties and their quality are defined by the users' actual requirements and the program's operating conditions. For example, a program that is designed to be used under constant operating conditions does not need properties associated with moving it to another environment. Based on this, software should be reviewed within the complex of properties that define them and should consider their interrelationship with their environment. When evaluating the quality of programs it is advisable to isolate the totality of the properties that define the suitability of software to process information in accordance with the functional designation of those properties which are considered essential in qualimetry. Their contents are conditioned by the interrelationship between the software and the distinct parts of the environment.

Table 2

Variation number	Environmental object	Program property	
1	V_1	1 1 1 1 1 1	$Q=P$
	V_2	1 1 1 1 1 1	
	S_1	1 1 1 1 1 1	
	S_2	1 1 1 1 1 1	
	S_3	1 1 1 1 1 1	
2	V_1	1 1 0 0 1 0	$P \cap U \neq 0$
	V_2	1 0 0 0 0 1	$P \cap \leqslant S$
	S_1	0 1 1 0 1 1	$Q=P \cap U$
	S_2	1 0 0 1 0 0	
	S_3	1 1 1 0 1 1	
3	V_1	1 0 1 1 1 0	$P \cap U \neq 0$
	V_2	0 1 0 1 0 1	$S \leqslant P \cap U$
	S_1	0 0 0 0 0 0	$Q=S$
	S_2	0 1 1 1 1 1	
	S_3	1 1 0 1 0 1	
4	V_1	1 0 1 0 0 1	$P \cap U \cap S \neq 0$
	V_2	0 1 0 1 1 0	$Q=P \cap U \cap S$
	S_1	0 1 0 0 1 0	
	S_2	1 0 0 1 0 0	
	S_3	0 0 1 0 1 1	
5	U_1	0 0 0 0 0 0	$P \cap U \cap S=0$
	U_2	0 0 0 0 0 0	$Q=0$
	S_1	0 0 0 0 0 0	
	S_2	0 0 0 0 0 0	
	S_3	0 0 0 0 0 0	

NOTE: 1 -- a software property accepted by the environmen (is formed in the developmental process and manifested in use and maintenance); 0 -- a software property that is not accepted by the environment.

The environment, i.e. the totality of things that interrelate with the software during its development, use and maintenance include:

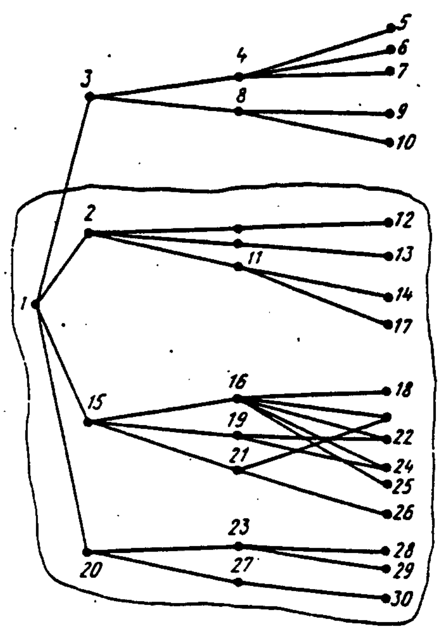
the organizational and technical conditions and the means for developing programs;

the users' requirements for the properties of software quality;

the conditions of the programs' use and maintenance;

GOST [State standard] and technical specifications and so forth.

When evaluating the quality of software (Footnote 5)(Yu. M. Andrianov and others: Kvalimetricheskiye Aspekty Upravleniya Kachesvom Novoy Tekhniki [The Qualimetric Aspecs of Controlling the Quality of New Equipment], Leningrad, LGY [Leningrad Order of Lenin and Order the Labor Red Banner State University imeni A. A. Zhdanov], 1983, p 288) the essential properties can be formulated in Table 2 ($P = \bigcup p_i$ -- the general set of software properties; $V = \bigcup v_i$ -- the set of properties which are formulated in the process of developing and maintaining programs through the use of various instrumentation and organizational-technological methods and so,obviously, $V \subseteq P$; $S = \bigcup s_k$ -- the set of properties of the programs which satisfy the requirements of the user and the operating conditions, $S \subseteq P$).



SOFTWARE PROPERTY TREE

1 - program quality; 2 - reliability; 3 - effectiveness; 4 - efficiency in using hardware; 5 - processor time; 6 - external device time; 7 - amount of memory; 8 - effectiveness of man's use; 9 - time required for operator maintenance; 10 - ease of understanding the form of output; 11 - correctness; 12 - operational stability; 13 - logical agreement; 14 - accuracy of results; 15 - adaptability; 16 - mobility; 17 - degree to which it fulfills its function; 18 - portability; 19 - ability to be modified; 20 - ease of use; 21 - compatibility; 22 - structure; 23 - documentation; 24 - adjustability; 25 - expandability; 26 - independence; 27 - consistency; 28 - completeness; 29 - clarity; 30 - consistency.

Software characteristics and properties can interrelate with the requirements and environmental conditions in the following manner:

all software properties that are formulated in its developmental process totally meet the requirements of the users and operating conditions. Then the software quality is defined by its entire property set, Q = P;

the software properties that are formulated in its developmental process partially satisy the requirements of the users and operational

conditions. Then the software quality is defined by the set of properties that were formed during its development, $Q = P \cap V$;

not all of the software properties are realized during its use. The quality of the software is defined by the requirements of its users and the operating conditions, $Q = S$;

part of the software's properties are sensed and some are not sensed by the environment. In this case the software quality is equal to the intersection of the magnitude of their properties and the environment, $Q = P \cap V \cap S$;

not one of the software properties meet the environmental requirements. The quality of such a program is minimul.

Thus, when evaluating the software quality it is necessary to isolate the set of essential properties which define the suitability of programs to transform information in accordance with their functional purpose.

The set of essential properties that characterizes the quality of software may be ordered and presented as a multi-level hierarchic structure which can be depicted as a tree-like graph (see illustration). The points of the graph are the software properties at one level of the hierarchy or another and the lines are the relationships between these properties. The illustration also shows the set of essential properties that characterize the qualities of the MARS [not further defined and signalling device] system and which were defined by the requirements of the user as well as by developmental and operating conditions. Since the properties of the hierarchy's fourth level are somewhat interdependent, the relationship among the elements of the third and fourth levels in the software property tree are depicted as crossed links.

The multi-level, hierarchic approach gives the structure and the software's qualitative elements conceptual unity. The subsequent decomposition of the concept of software quality allows the structure of the properties to be established at the hierarchic level required to resolve the specific tasks of measuring and evaluating the software quality while considering the environmental influence.

12511
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SOFTWARE FOR COMPUTER TECHNOLOGY

Moscow EKONOMICHESKAYA GAZETA in Russian No 47, Nov 85 p 10

[Article by Professor V.A. Myasnikov under the rubric "Computer Literacy School": "Microprocessors: Head of Main Administration of Computer Technology and Management Systems of State Committee of Council of Ministers of USSR for Science and Technology Conducts Third Lesson"]

[Text] Computers manage complex production complexes and flexible manufacturing systems, provide the operation of automated design or automated scientific research systems, are used in instruction, play chess, and compose music. However, they can't do anything by themselves. They are capable of acting only in the presence of programs.

The program is a product of a human individual or collective intellectual effort that is implemented on the basis of knowledge possessed in one area or another and shaped in the form of a logical sequence of operations (commands).

In the context of the revolutionary progress in microelectronics, the specific cost of a computer operation and main memory has decreased rapidly. In the past 15 years, the productivity of computers has grown a hundred thousandfold, and the cost of implementing one operation has decreased a millionfold.

Expenditures on software have increased in relation to the expansion and complication of the tasks solvable, approaching the amounts spent for the acquisition of the computer technology itself. To an increasingly greater degree, computers are being used to process not only digital but also semantic (text, graphic, image) information. Software is an unusual commodity. The main expenditures for its creation are for development and maintenance, with only a little for production and publication.

Software is a program or complex of programs on a data carrier with technical (including program and operational) documentation. The process of its creation is characterized by the chain: task-model-algorithm-program.

The intention and need for some kind of automated complex with a computer or for a data processing system are formed first; then, the purposes and areas of use are determined. The problem formulated is subdivided into a number of specific problems according to which the specifications of the functions are compiled, the mathematical models are developed, and the engineering job is

coordinated. Next, the internal architecture, the draft or engineering design with a complex of computer algorthms, is determined. Finally, the modular structure and the intermodular interfaces are drawn up, the development of the text of the program and debugging tests as well as that of the technical documentation are undertaken, and the unit test and integrated debugging of the program is implemented.

In accordance with the Statewide Program for the Creation, Production Development, and Efffective Use of Computer Technology and Automated Systems [CGP], the number of computers of various classes in the economy, including personal computers, has grown sharply. At the same time, it should be considered that communicating with a computer, knowing how to program, has become a second literacy in our eyes.

In June 1985, the USSR State Committee of the Council of Ministers of the USSR for Science and Technology [GKNT] set forth its position concerning standard technologies for developing computer software. In the given case, development technology is a powerful means of improving labor productivity in programming, shortening the times and cost of development, and increasing the quality and reliability of software.

At present, the Main Administration of Computer Technology and Management Systems of the GKNT together with interested ministries and departments is conducting a project on the issue of All-Union administrative and normative documents that will make it possible to provide program production output of a completely new form.

The State Fund of Algorithms and Programs [GosFAP] has been created to bring software to users in our country. Its activity is directed toward increasing the effectiveness of using computer technology in the economy as well as toward eliminating duplication of effort in creating software and improving its quality. The functions of the main administration of the GosFAP have been placed in the All-Union Interbranch Scientific-Research Center for Production Organization and Use of Software in Computer Technology.

12794
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IN SEARCH OF COMPUTER TIME

Moscow EKONOMICHESKAYA GAZETA in Russian No 3, Jan 86, p 12

[Article by V. Skachkov, Engineer-Economist, Inspector from the Khabarovskiy Kray Committee of National Control]

[Text]

*ASU Out of Use

*There is a System - There is no System

*Rejection of Dialogue with a Computer

It is doubtful whether someone today needs to prove how much the effectiveness of all our economic activities would rise and science and technology progress accelerate, if the computer were run with a high workload level and the possibilities of ASU (automated control system) were maximally utilized. And how many fewer mistakes, at times irreparable, would we permit in administrative activities! And what is interesting, everyone gives the appearance in words of knowing this in order to avoid being reputed to be a conservative, and they advocate more complete utilization of "electronic potential", but in practice many are still far from approaches to the solution of the program.

As an example, in the Khabarovskiy Kray, during the last Five-Year Plan the computer stock almost doubled in size. Here 61 computer centers were created containing 193 computers.

The cost of the equipment reached 100 million rubles. Ponder this figure -- what possibilities are opened up here!

But here not long ago, I personally had occasion to take part in one of the most serious inspections. The activities of 21 ASUPs (automated enterprise control systems) and computer centers were analyzed, data was studied of statistical reports of the work of the computer in 22 enterprises and in all, more than 75 percent of computer centers and systems were inspected. This is the picture that was revealed.

At the beginning for objectivity about the pluses. Quite a bit of instructive (material) was found at the Khabarovskiy Shipbuilding plant imeni USSR 60th Anniversary and the Komsomolskiy-on-Amur aircraft plant imeni Yu. A. Gagarin. Computer complexes here are loaded completely, the nature of the jobs that we run promotes further growth of the effectiveness of production, an increase in labor productivity, and eocnomy of material resources. Affairs also run well at these enterprises. Computer centers of the "Vostok" unified dispatch management of Minenergo USSR, the USSR Academy of Sciences Scientific Center, and the Khabarovskiy Statistical Administration, work with full load and above all with benefits for business.

But far more minuses were found. Computers were running significantly below established standards in 20 organizations, computer time was ineffectively used in the "Dal'geologiya" and "Dal'shveyprom" associations, at the Amurskiy Paper-Cardboard Combine, the "Dal'energomash" plant and Birobidzhanskiy power transformer plant, in "Dal'giprovodkhoz" and "Dal'giprotrans", and what is entirely inexcusable, in the Kray Bureau office of Stroybank USSR, and the Khabarovskiy Polytechnic Institute. Just think about these numbers: in 1985, 7,042 machine-hours for 608.5 thousand rubles were lost.

What does this analysis show? Computers stand idle because of weak software, low hardware maintenance, and finally because of elementary lack of work. In the first half of 1985 alone the workload in the kray fell below the planned targets by 6,326 hours and by 40,978 hours below the standard approved by GKNT, TsSU, and the USSR Academy of Sciences. Total losses of computer time during the year are equal to the downtime of 10 computer centers, which are equipped with YeS-1033 computers (high-speed operation, average throughout). Their activities could be recompensed by the sum of 3.5 million rubles.

In labor collectives up to now, calculations of assignments are not planned for lowering production and economy of human labor or even for increase of labor productivity based on the programs which have been developed. Similar calculations are not being made even now in shipbuilding enterprises, which were the first in the kray to begin to assimilate the computer. That was still in 1978. In the Khabarovskiy section of the "Elektroproyekt" Institute only 25 percent of computer time is utilized for its own needs. It is no wonder that the exchange of data between industrial subdivisions and computer centers, even by the owners of computers, is carried out in the most primitive ways -- based on "manual" documents. Communication devices, terminals, and user stations are absent. In short a hitch springs up in the management system. The result is deplorable. The number of calculation workers in enterprises is not diminished, and the workload of each of them is not reduced.

Facts testify that often the responsibility of the managers for timely incorporation of the electronic equipment is diminished. So, in 1983 the "Khabarovskrybprom" Association acquired seven "Iskra-555" microcomputers at a cost greater than 100 thousand rubles. Today only one computer is being used, and even then only by half -- with a standard of 4 machine-hours in 24 hours, it is running 2.2 hours.

A year ago acts were written about the placing of two computers into operation at the Komsomolskiy Fishing Combine, but they have not been carried out in practice. Up until now three computers at the Sovgavanskiy base of the Ocean Fishery had not finished installation, and Khabarovskrybprom alone loses over 300 thousand rubles annually on that.

Yet another example. Management of the housing-municipal economy of the Krayispolkom, in an attempt to inch closer to the front line of technical progress, acquired a Yes-1033 computer in 1982 at a cost of almost half a million rubles. An entire two years was wasted on installation and adjustment of the computer instead of the six month norm. For software, plans were developed for the automated control systems "Kraykomkhoz", "Vodoprovod", and "Svyaz'", which also cost quite a bit of money -- 660 thousand rubles.

Resources are spent, and the result? Not one of the systems up to the present is installed. And what is more -- the computer is rented and operated by the Special Design Bureau of ASU of Minpribor. At the same time the city housing administration, an owner of computer hardware, continues living in the past. There is no department of ASU here, the computer load is not monitored. At the same time cases of misrepresentation of statistical bookkeeping about the computer work are allowed.

Apparently it will be proper to name the culprit of permitted mismanagement. The Kray Committee of National Control holds the chief engineer of the "Khabarovskrybprom" Association, G. Gordeyev, and management of housing and municipal services, E. Yudin fully accountable. They have been made to answer severely. The inertness and passiveness which has been allowed in assimilating the computer and ASU has been pointed out to other managers.

We must reflect on similar cases in corresponding departments and ministries. To what relaxed control leads is well seen in the example of NPO "Dal'standart", which has nine computer complexes. More than half the computers here are operated in one shift, although the standards stipulate two. An SM-3 has been idle 5 years already. Accounting journals of computer time and useful load of computers are not kept. An account of the work of the computer centers is not filled out, which is necessary to send to higher organizations and state management. All that became possible in part from the diminished feeling of responsibility of the general director of "Dal'standart", E. Lipovetskiy. Even local agencies of Gosstandart do not pay attention to elementary violations.

This circumstance also lowers the effectiveness of computer use: managers of higher and especially middle sections do not use the computer in a direct dialogue mode -- for analysis of planned indices, the established situation in a section or in a department, and even for selection of a necessary solution. Managers of subdivisions and economists as a rule do not offer opportunities for the use of computers in their practical work.

It is necessary to teach specialists modern methods of control: otherwise, it will be more difficult to move technical progress ahead. However, such studies in the kray are not going on. In 1985, the Palace of Engineering

organized courses for specialists. Sixty-eight people were engaged in the 150-hour-long program in 2 streams. But among the students were only three engineers.

The problem of training and retraining of personnel for computer use is not solved by single measures. Initiatives of the Kray Palace of Engineering are clearly insufficient. Here a system and long-term planning are needed. In addition it is necessary to be aware of practical requests and needs of the computer owners for cadres. But the Palace of Engineering can give only the minimum: it does not have enough material resources, not even a computer.

It is impossible not to pay attention to another problem. Large enterprises and organizations which have the necessary means at their disposal can provide themselves with computers. In other collectives, the problems of automation of management are not solved in practice. That means the path to effective and rational use of the computer is collective use of computer centers. It is necessary to consolidate efforts of concerned organizations and their material and financial means among departments. Therefore the ground is vanishing for amateur work in the uses of computer time and in computer education for managers of the middle section, economists, designers and engineers.

The problems, as we see, are not few. Even in the Basic Directions it should be written: "Enhance the responsibility for operation of computer centers and computers, create a system of training and retraining of specialists for them, and organize a unified service for maintenance of computer hardware".

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INFORMATION SYSTEMS FOR LIBRARY DATABASES ORGANIZED

Tallinn RAHVA HÄÄL in Estonian 31 Jul 85 p 2

[Article by Toomas Etverk, Director of Science of the Estonian Information Institute, titled "Nota Bene! Progress in Technology"]

One of the important resources for speeding up the progress in science and technology is the fluent information system about the achievements of science and technology. With the help of this information, the scientist, the specialist, and the leader can decide in which direction to move on, which solutions to try, etc.

[Text] The two subestablishments of the ESSR - the Institute of Information and the Center of Computation - are having a common exhibit at the exposition "Soviet Estonia 1985": The Automated Remote Inquiry System of Scientific Information (Teadusinfo Remote Automatiseeritud Kaugotsingu Süsteem - TAKS). The terminal device which is located in the exposition hall on Pirita Way has been connected by the lines of communication with the computer which is located in the center of the city. Some bibliographical data have been stored in its memory bank (the author, the title, the place of publication, the indices which given an overview to the content, keywords, volume, and others) about the scientific and technical articles, books and other documents which have been published in the world. This information is stored in three separate data bases. The first of these bases consists of data about the publications concerning library and about information about working places; the second one concerns the area of computer programming. The third base is very broad as far as topics are concerned, but it reflects only books which have been published outside of Estonia and which are only found in the libraries in Estonia. This compiled-mechanized catalogue of the Republic of foreign publications has been compiled as a common project by the institute and by the Library of Fr.R. Kreutzwald of the Estonian SSR. Over 20 leading libraries give data regularly to the Library of Fr.R. Kreutzwald of the Estonian SSR, among them the Academy of Sciences, the State Institute of Tallinn.

With the help of the keyboard of the terminal which is located in the exposition hall, the operator feeds into the computer an inquiry. This inquiry is in the range of the specialty of the terminal and it characterizes the field of science or technology and the problems in this field about which one wishes to get some literature. The reply of the computer comes to the screen

of the terminal: first it notifies how many documents are in its memory which satisfy the given inquiry. If the number of documents is very large, for example in the hundreds, then the operator has to specify the inquiry bv means of the keyboard, add specialized terminology or keywords; some keyword which is too broad has to be substituted with a more concrete one, and one has to correct some other demand. Such a dialogue between the operator and the computer is carried on in such a speedy manner that one gets the impression about a real unrestrained conversation in which course the need of the information of the human being is being adjusted, and finally the computer gives out the bibliographical data about the needed publications either on the screen of the terminal or already printed on paper. The results of an average 10-15 minute search are data which had it been gotten through the traditional way would have required the researcher to have spent many hours of work in the bibliographical department of some library thumbing through some old yearly publications. The system works more effectively the bigger its temporal depth of data base is and the more topical scope and the more primary sources it expresses. The TAKS which is on exhibit is, for the time being, modest; it has been created, first of all for learning and teaching. The creators of the system had in the course of its making necessary knowledge and experiences. The topics of the data bases have been chosen so that, above all, they would be easy for the information workers, for the workers in the library, and for the specialists in computer technology to practice with them. It should be easy for people who in the near future would have to be using this system in mass and will also be creating on their own computers similar bibliographical and retrospective data bases.

In the Soviet Union, an Automated System of the State Science and Technology Information is being established which comprises tens of large information centers. One of the largest among them is an All-Union Information Institute (VINITI) whose task is to collect and produce materials which have been published in the world in the fields of natural, exact, and technical sciences, to compose their bibliographical data, reports, and to forward the thus-formed information flow to the users - to the scientists, to the specialists, and to the leaders of national economy. VINITI has done this work for years already in the forms which have become traditional: printed booklets containing bibliographical signal information, report publications, analytical surveys such as "Results in Science and Technology," etc. At the end of the 70s, procurement of the bibliographical and report information along with the above-mentioned magazines was started also on magnetic tapes for computers in a suitable manner. These so-called magnetic tape data bases became fast popular as "sources of raw materials" for the automated systems of the information institutes which were working at the federal ministeries and at the planning committees of the republics. The Estonian Information Institute is also using VINITI and other magnetic tape data bases of the other large information organizations with over one-and-a-half million pieces of data per year. In order to inform its users by means of the computer of new materials which are of interest to their fields, the system of selective dissemination of information, VALTER, has been employed. Up to now, the automation has been confined just to spreading the news. After the magnetic tape data base has been looked over and necessary material has been printed, then the original data are being erased.

The final stages of the 5-year plan bring into the state information system in quality a new phenomenon - the retrosystems which have been automated by the remote search. One representative of this is the one which is exhibited, TAKS. The data which have thus far been spread by the magnetic tapes and are used just once are being gathered into large permanent data bases which in the course of time will start to reflect material of scientific and of many technological fields which have appeared over the years. Access to these data banks located in large centers has to be warranted from all scientific and work centers of the USSR. This access is achieved in the same operation like the visitor of the exhibit who can now turn to the memory of the computer which is located in the center of the city and from there is able to quickly search the necessary data. In this manner, in the future the Estonian scientist and specialist can find most of the retrospective bibliographical information necessary to him already directly from the data banks of the large information centers of Moscow. It is necessary, however, to create supplemental data banks locally: on one hand about Estonia, on the other hand data which are of interest to the Estonian national economy specifically. The representative of the first class in the above-described collective mechanized catalogue of the foreign publications of the republic; it is simply embarrassing to ask inexhaustible information about the status of our libraries from other sources; one has to secure this with one's own forces. The so-called problem-oriented data banks belong to the second class, which should be created in the computers of their research institutions which have a leading role in the solving of certain scientific or technological problem, especially if it concerns the primary interests and needs of the republic and are not particularly topical in the other regions of the USSR. Into this category would of course belong all so-called national sciences (the science of language and literature, ethnography, etc.) and also the researching of our most important natural resources - oil shale, phosphate rock, and others. It is also not advisable to depend on the production of only the all-union's "information industry" in the fields in which our science is on the level of the world, because new information often reaches the top scientist through unofficial channels earlier and more exhaustively than through large information centers which are more powerful but at the same time their machinery is unavoidably clumsier. Our Institute of Chemistry of the Academy of Sciences has perhaps most experiences in establishing the problem-oriented data banks.

For the effective use of the bibliographical retrospective data bases, it is necessary that the user would have access to them easily and at a time which is suitable to him. There would be easy access when the terminals are accessible directly at the work places of the user or in the bibliographical sections of large libraries. It is necessary, sooner or later, to obtain their own terminals for all scientific, forecasting, and construction institutes and to plug them into the all-union data system - of course not only in order to use the services of TAKS of the Estonian Information Institute, but also to be able to use the data banks with the tele-turning devices of the entire republic's information system. Only this does not suffice, the terminals have to be chosen so that with their help it would be possible to also plug into the automated control systems. This task is not completely

solvable right now; the basic obstacle is in the weakness of the data-forwarding networks, but we are moving perspectively in that direction.

At the present time, the requirement of acquiring computer knowledge has been set. It is also typical in the use of the field of scientific and technical information.

Toomas Etverk,
Director of Science of the Estonian Information Institute

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DISTINCTIVE FEATURES OF ALLOWING FOR TIME FACTOR WHEN COMPUTING ECONOMIC EFFECTIVENESS INDICATORS OF MANAGEMENT INFORMATION SYSTEM

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 21, No 5, Sep-Oct 85, pp 935-937

[Article by B. V. Timonkin, Kiyev]

[Text] Providing the time comparability of all indexes used is a necessary condition of evaluating the effectiveness of expenditures for management automation systems [ASU]; up to now, these methods have not been developed sufficiently. The general methods that were introduced in 1974-1975 posed the requirement of the time comparability of all indexes in time; however, they not give specific instructions with respect to discounting them, leaving open the question of which indicators are involved and how to implement this requirement.

Such a situation hindered using the principle of the time comparability of indexes in practice and was aggravated by contradictory recommendations [3-5]. For example, work [3] proposes carrying only preproduction expenditures over to one moment in time. The method in [4], on the other hand, proposes carrying only capital investments for the creation and introduction of systems and the running expenditures for their operation over to the beginning of the accounting year. Some works (particularly [5]) emphasize the necessity of discounting all expenditures for the ASU as well as all the profit obtained from its functioning. These suggestions, which in our view are completely correct, were reinforced by method [6], in accordance with which the allowance for the time factor is accomplished by carrying over to one moment (the beginning of the accounting year) the one-time and running expenditures for creating and introducing new and base technology and the results of their use. This is implemented by multiplying (dividing) the expenditures and results of the corresponding year by the carryover coefficient α_i, which may be determined according to the formula

$$\alpha_i = (1 + E_{co})^t, \qquad (1)$$

where E_{co} is the carryover norm, t is the number of years separating the expenditures and the results of a given year from the beginning of the accounting year. Expenditures and results for the years preceding the accounting year are multiplied by the carryover factor, and after the beginning of the accounting

year, are divided by it. The total one-time expenditures K, which are carried over to the moment of introduction [6, p 31], are computed as

$$K=\sum_{t=1}^{T} K_t \alpha_t, \qquad (2)$$

where K_t is the capital investment of year t in rubles and T is the total duration of the process of creating and assimilating the new technology in years.

There is no special expression for carrying over the annual economy (profit growth) in [6], and, at first glance, it seems that one is not needed because of the previously mentioned clear recommendation on this count. However, it will be seen that one would be useful in computing the indexes of economic effectiveness, in particular, the effectiveness factor of expenditures on the example of two ASUs that are created according to an identical design on identical objects and that differ only in terms of the dynamics of the annual economy in the period preceding their complete introduction. The source data are presented in the table. The operating costs are calculated in the determination of the annual economy and do not figure in the computations independently. The year 1981 is taken as the accounting year (complete introduction).

From the assertion that the annual economy obtained before the beginning of the computational year is multiplied, and after its beginning, divided by the carryover factor [6], it follows that in the accounting year (complete introduction), the annual economy is generally not corrected by the carryover coefficient and is calculated without change.

The coefficients of the economic effectiveness of the expenditures for ASU_1 and ASU_2, which are computed according to the data in the table with an allowance for the time factor, constitute

$$E_{P_1}=E_{P_2}=\frac{500}{50\times1{,}1^5+150\times1{,}1^4+700\times1{,}1^3+200\times1{,}1^2+150\times1{,}1^1+50\times1{,}1^0}=0{,}30.$$

It is not difficult to see that such a procedure for carrying over the annual economy ignores the protracted, stage-by-stage nature of the process of attaining the level of the accounting year, i.e., the economic effect of the functioning of the ASU begins to accumulate long before the complete introduction of the system (or its stages) in proportion to when its individual tasks or subsystems are placed in operation. In so doing, computing the time factor in

the accounting year has a limiting character and applies only to one-time expenditures. Indeed, the growth dynamics of the annual economy for the introduction period are far from being without difference for society. Previously obtained results, such as previously made expenditures, are more valuable, and it is therefore necessary to make an allowance for the time factor in economic research.

Table

Indexes	Years					
	1976	1977	1978	1979	1980	1981
Capital investments	50	150	700	200	150	50
Annual economy from functioning of ASU_1	--	--	--	150	310	500
Annual economy from functioning of ASU_2	--	--	--	50	130	500
Growth in annual economy from ASU_1	--	--	--	150	160	190
Growth in annual economy from ASU_2	--	--	--	50	80	370

It can be shown that the specified shortcoming can be eliminated when formula 2 is used to discount the annual economy. However, it is not possible to use it to carry over the annual economy when determining the effectiveness coefficient inasmuch as the numerator of the corresponding expression will, in this case, be the total economy for several years, and the essence of the index that reflects the annual rather than the total economy for a certain period per ruble for a one-time expenditure will be completely distorted.

A similar situation arises when (2) is used to carry over the annual economy in the process of calculating the annual economic effect. The essence of the index "annual economic effect" lies in the computation of the absolute value of the deviation of the actual annual economy (profit growth) from the norm, which may be determined by the product of the normative effectiveness factor and the volume of one-time expenditures. Therefore, when the annual economy is replaced by its total value for a number of years, the comparability of the two indexes being compared is destroyed, and the resultant expression loses its meaning.

The answer, in our view, is to include in the computations only those values of ecomomic growth for the years preceding the year of introduction, the sum of which is equal to the economy in the accounting year. Multiplying the individual components of this economy by the corresponding values of the coefficient α_i makes it possible to make an allowance for the inequality in the values of one or another dynamics of attaining an end result account (the annual economy in the accounting year) for the economy as if to "reward" the results obtained previously and to thereby provide the time comparability of the components of the economy.

The proposed method does not impair the general principal of carrying indexes having diverse times over to one moment. Indeed, when the one-time costs are discounted, the expenditures of the past years (before the accounting moment) are "penalized" by means of multiplication by the coefficient α_i, which depends on the duration of the period between the years of their implementation and complete introduction. Still another analogy may be drawn between these two methods. The expenditures of individual years, whose sum equals a specified value, are components of the total one-time expenditures for the moment of the creation of the ASU. In turn, the growth in the economy obtained in previous years (as a result of the development of the functional part of the ASU, improvement of operating modes, etc.), whose sum is also equal to the economy of the accounting year, serves as components of the volume of the economy in the year of the complete introduction of the system. In this case

$$E_{P_1} = \frac{150\times1{,}1^2+160\times1{,}1^1+190\times1{,}1^0}{50\times1{,}1^5+150\times1{,}1^4+700\times1{,}1^3+200\times1{,}1^2+150\times1{,}1^1+50\times1{,}1^0} = 0{,}32,$$

$$E_{P_2} = \frac{50\times1{,}1^2+80\times1{,}1^1+370\times1{,}1^0}{50\times1{,}1^5+150\times1{,}1^4+700\times1{,}1^3+200\times1{,}1^2+150\times1{,}1^1+50\times1{,}1^0} = 0{,}30.$$

The index computed in this manner reflects the preferability of the first system, the design organization of which provided a higher growth rate of the annual economy in the initial period of introduction (1979-1980).

It is not complicated to show that an analogous position with discounting of an economy also has its place in determining the annual economic effect.

Consequently, it is possible to implement the calculation of the annual economy E when computing the effectiveness coefficient and annual economic effect solely in relation to its growth in the years preceding its introduction according to the formula

$$Э = \sum_{t=t_0}^{t_в} \Delta Э_t (1+E_{нп})^{t_в-t}, \quad (1)$$

Key:

1. E_{co}

where $\Delta э_t$ is the growth in the annual economy in year t in rubles; E_{co} is the carryover norm, which equals 0.1; t is the year in which the computations are implemented; t_0 is the year of the initial introduction of the system; and t_B is the year of the introduction of the system.

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QUALITY CONTROL AUTOMATION WHEN USING PROGRAM-GOAL PLANNING

Moscow PRIBORY I SISTEMY UPRAVLENIYA No 9, Sep 85 pp 39-42

[Article by Candidate of Technical Sciences V. P. Minayev, under the rubric: "Production Organization and Economics"]

[Annotation] Production quality "is the most precise and telling indicator of scientific and technical progress, culture and labor discipline."

"Production quality must be the object of not only occupational, but national pride."

M. S. Gorbachev. "Fundamental Problem of Party Economic Politics," PRAVDA, 12 Jun 1985.

[Text] Increasing the technical sophistication and quality of manufactured instruments together with the replacement strategies adopted determines, in the end, the amount of growth required in the instrument-building sector. This work is being conducted at Minpribor within the framework of "Kachestvo" ["Quality"] integrated sector program, which assures high production quality stability. The "Kachestvo" program together with several other sector programs has been called upon to guarantee a systematic and significant increase in production quality and reliability.

The "Kachestvo" program was started up in 1983. A number of principles [1] which are examined here were taken as its basis: control must be based on program-goal planning and be realized in the form of balanced sector growth programs for the planned period; the programs are a means of achieving specific and measurable indicators stipulated by the planned tasks of the sector for the planned period: the production quality indicator [PQI] and labor quality indicator [LQI]; the necessity of realizing a certain innovation, including the development of a KSUKP [integrated system for quality control in products] at specific enterprises, is revealed in the development of the "Kachestvo" program and is stipulated by centrally assigned LQI and PQI; the program at each control level (sector, subsector [all-union association], organization) is determined by the following components: LQI, PQI, and a list of consolidated problem blocks and problems whose realization will enable

indicators of a given level to be achieved; the effective costs for the realization of the program must be minimized in the derivation of centrally assigned PQI; the program is created through successive iteration: here the analysis of the capabilities and effectiveness of individual innovations in achieving the final goals is required; when compiling a list of specific tasks (innovations) at each level, the systemization of the tasks set forth in the standard [2] developed and augmented for the specific sector, for example in the sector standard, must be utilized at each level to the maximum degree; the implementation of a program compiled for a five-year period is checked every year by indicators that characterize the extent to which the tasks assigned in the program have been fulfilled.

Subsector programs, industrial association [PO], scientific industrial association [NPO], enterprise and organization programs were developed on the basis of the sector program. A system of goals and procedures differentiated and distributed according to the executor that assured their achievement was established in the programs.

The realization of the listed principles requires that the highest administrative levels clearly understand the goals, trends, and most importantly, the capabilities of the sector in increasing production quality, as well as the possibility of making resource breakdown analyses to realize the required production quality control [UKP] strategies. All of this can be realized only if the computer is used as a tool to solve these tasks within the framework of the automated control systems [ASU] of the different levels possessing a highly-developed data acquisition system.

Diagram 1 shows examples of fundamental production quality tasks which are automated at the corresponding production control levels. An analysis of them yields a number of conclusions. First, the greatest number of tasks is solved at the enterprise level, which is to be expected since manufacturing is the basis of the UKP in the sector. Second, of all the tasks, those which can be solved at higher levels possess greater significance and more optimal economic consequences. Third, the role of tasks directly associated with the control of manufacturing processes and production operations can easily be seen to increase in proportion with the degree of automation. Finally, UKP and the automation of this process require a clear goal-oriented approach to the development of a single scheme that ties together the system functions at all control levels.

The automation of the UKP functions in Minpribor is a component of the KSUKP and is built upon the basis of the "ASU-Pribor" sector automated system and the ASU's of enterprises and organizations. The UKP tasks are solved in the "ASU-Pribor" in a series of subsystems and primarily in the "Production Quality Control" subsystem. The latter can solve tasks in: production output planning and analysis; level of technical sophistication of products; development planning and accounting; introduction and implementation of standards; effective production quality control; planning and control of metrologic support facility development; planning and control of tests; evaluation of the production quality awareness of enterprises; analysis of the age structure of instrument building industry products.

Quality control levels

I	II	III	IV	V	VI	VII	VIII
Manufacturing process, production operation	Work station	Bay	Shop (section)	Production unit	PO (enterprise), NII, (KB)	VPO	Ministry, State control organs henceforth

Evaluation and analysis of product reliability indicators

Planning, monitoring and analysis of testing

Accounting and analysis of faulty products

Calculation and analysis of production pace

Planning, control and analysis of production of objects with State Mark of Quality

Prediction of manufacturing process stability

Planning and monitoring of product replacement

Accounting and monitoring of the measuring facility park condition

Accounting and monitoring of material and energy input

Monitoring the implementation of measures for the realization of planned quality indicators

Evaluation of the enterprise (PO) efforts

Accounting and monitoring of supplied object quality

Evaluation of the efforts of subdivisions and executors

Accounting and analysis of claims

Diagram 1

More than 30 task suites that realize special KSUKP functions make up the ASU of sector enterprises. These are tasks associated with the accounting and analysis of faulty products and losses caused by them, and production quality claims and complaints; estimation of the level of defect-free labor; estimation of the quality of materials and furnished objects; estimation and analysis of procedures aimed at increasing production quality; steady production pace calculations, etc. In the case of initial development organizations these tasks involve the evaluation of the quality of the production forms and records and the work of the subdivisions and executors, checking the executors' discipline, and analyzing the production activity indicators, etc.

State and sector normative production forms and records regarding production quality and enterprise standards comprise the methodological and organizational basis of these tasks. Standard design solutions are quite widely used in the development process.

Various services and the management of the enterprises and organizations use the production quality solution results to solve current UKP problems, estimate and analyze the causes of low production quality, evaluate the efforts of enterprises and subdivisions in increasing production quality, to summarize the results of socialist competition, and to estimate the effectiveness of the KSUKP.

An analysis of the tasks that automate the UKP functions in the ASU's of various levels shows that they possess a number of faults, among the most important of which are: the comparatively limited and uneven coverage by automation of the KSUKP functions; the "isolation" of production control tasks, i.e., the weak interconnection and interfacing of task solution results of different ASU's, both at one level (one subsector) and at different levels; the almost complete absence of tasks that prevent and eliminate intolerable production deviations from assigned quality parameters; the absence of tasks to analyze the effect of various factors and resources on single and aggregated quality indicators and the technical sophistication level of products; the small number of predictive and optimizing, resource distribution and decision-making tasks; the suboptimal selection and distribution of production quality data in ASU's of different levels, which causes either unnecessary duplication or the complete absence of the data.

The majority of the listed problems are tied with the imperfection of the branch production quality planning mechanism and its control.

Program-goal UKP with greater use than before of ASU should provide: automation of production quality problems at all stages of the production life cycle; the coverage of all the special UKP functions (in accordance with the GOST 24525.2-80); "depth" of the production quality problem solutions, i.e., their solution at all control levels: sector, enterprise (organization), subdivision (service), bay, work station; the establishment of a PQI system that describes the economic mechanism of the UKP. The latter point is extremely important since this problem was not unambiguously solved at preceding steps.

The mentioned methodological instructions present an objectively necessary set of tasks oriented to the long-term future. The composition of the tasks will change in accordance with the policy of the enterprise. Their implementation at the enterprise can be accomplished with current design methods with maximal use of standard design solutions. Thus, for example, the production quality control applications package developed at the "Lenelektronmash" NPO for the ASU's of enterprises whose computer centers are equipped with the YeS computer with OS operating system can be used to solve the majority of these tasks.

The tenets of the Methodological Instructions 25 461-82 and 25 464-82 must be considered when implementing the mentioned applications package.

The Industrial Associations of the Ministry are currently conducting a program for the simultaneous development of: an ASU for production-economic work, manufacturing processes and scientific research; automated design systems; automated inspection systems, etc. Each of these systems solves tasks that directly affect production quality. Thus UKP automation work must be oriented to the development of an integrated ASU.

An analysis of the over-all picture of the efforts of enterprises to provide high production quality and its plan-conformity control can be accomplished, in our view, by maintaining an "Enterprise Quality Document" within the framework of the ASU's of the enterprises. This descriptive document contains the basic technical-economic and organizational PQI's and reflects their dynamics (diagram 2). The document is based on indicators which are transmitted to the organs of the Central Statistical Administration and the "ASU-Pribor", and are also used as part of the ASU's existing at the enterprises. Among the primary tasks connected with the program-goal control and maintenance of the document, one should note task complexes that estimate expenditures required to improve quality and the technical level of sophistication of the products, analyze production quality increase in the enterprise technical and economic planning and that monitor the execution of the "Kachestvo" program tasks.

The processing of the document data could be accomplished, for example, in the "ASU-Standartpribor" with the goal of analyzing in detail the production quality efforts of the sector, producing valid plans and programs aimed at increasing production quality and the technical level of sophistication of sector products, and the centralized allocation of resources to accomplish these goals.

The regulating apparatus of automation that determines the requirements of control functions' content and implementation, and the rights and responsibilities of officials and executors must, in program-goal UKP, as usual, base itself on the technical standards documentation of the sector and state levels and on other regulating documents.

Here the technical standards documentation of the UKP system must be developed further, extending the applicability of such documentation to control process automation, which will assure the necessary legal level of automated UKP in the sector.

Diagram 2

Enterprise Quality Document

Generalized PQI

+ Proportion of highest quality products (VKK) in total commercial production volume (TP)
+ Proportion of new products (up to 3 years) in the TP volume
+ Production volume (OP) for export
+ OP of cultural-personal and domestic products of high quality with "N" index

PTU and PQI

+ MTBF
+ Weight
+ Energy input
+ Other priority indicators (precision, over-all dimensions, aesthetics, etc.)

Proportion of uncertified products
Proportion of first-quality category products

LQI

+ Proportion of faulty product losses in production costs
+ Proportion of re-claimed products in the total TP volume
+ Proportion of primary materials per one million rubles TP
+ Proportion of energy-fuel resources per one million rubles TP

Proportion of certified technological processes
Number of product returns
Number of workers with an individual mark
Proportion of certified work stations
Number of self-monitored bays
Number of subdivisions with contract-brigades
Number of internal shop returns

Economic PQI

Capital outlays to increase KP
Current outlays to increase KP
Total incentive increases to wholesale price of VKK products
Total sum of additional profit from certified products with State Mark of Quality and "N" index
VKK TP production costs
Outlays per 1 ruble of VKK TP
Total outlays for development and support of UKP system (ASU UKP)
Total outlays for KP support, monitoring and administration services
Faulty product losses
Outlays for correction of faulty products
Total penalties for delivery of poor-quality products

Maintenance PQI

+ OP with microelectronic and microprocessor technology
+ Volume of obsolete products no longer produced
+ Level of technology
+ Level of utilization of automated monitoring systems

Organizational PQI

Presence of UKP system
Presence of enterpise standards
Presence of ASU KP: number of tasks; yearly economic gain
Presence of UKP service

Note: The "+" sign denotes indicators stipulated in the "Kachestvo" program.

Legend: PTU designates indicators of the level of technical sophistication of products.

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CSO: 1863/105

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AUTOMATED EXPERIMENTAL SYSTEM FOR STUDY OF OPERATOR ACTIVITY

Moscow TEKHNICHESKAYA ESTETIKA in Russian No 10, Oct 85 (manuscript received 13 Feb 85) pp 16-18

[Article by I. Yu. Zaglyadnov and V. K. Kalin, candidate of psychological sciences, Simferopol State University]

[Text] Using automated systems for scientific research (ASNI) increases the effectiveness of obtaining and analyzing information, frees the researcher in the experiment from routine operations, and provides him the capability of devoting considerable time to observing the work of the person being tested. Making the experimenter's work easier is especially necessary in studying group activity, when it is not only rather difficult to record the behavior of the people being tested, but it is also important to assess the effect of particular situations on the features of the process and results of the work of each member in the group [6]. It is impossible to set up such an experiment without equipment controlled by a computer.

In connection with the fact that an operator, as a rule, does not work with real objects, but with information models [10, pp 55-56], activity can be modeled under laboratory conditions on automated test beds which include general-purpose facilities for information display and a control computer. Using such hardware to plan operator activity is most promising. Piloting research in this case considerably reduces design time and allows considering a large quantity of alternatives at minimal cost and, as a result, well substantiating the optimality of the solution selected.

The use of automated scientific research systems is also promising in ergonomic studies when it is necessary to evaluate the operation of those man-machine systems in which reproducing the required situation for study purposes under natural conditions is impossible or difficult for some reason. Thanks to automated scientific research systems, the capability of placing an operator in the conditions required is emerging.

Some researchers are opposed to using computers in the line of an experiment explaining this by the fact that at the "output," we obtain an impersonal "human factor" and are denied the capability of analyzing marked deviations and "misses" in the responses of a particular operator. In the process, it is rightly noted that the most interesting psychological picture is often behind

such "misses," while upper and lower bounds for each parameter are entered, as a rule, into a data processing program on a computer. A computer can not only "absorb" and ignore marked deviations from the norm, but also especially identify them. In doing so, simultaneous processing of comprehensive information on the "man-machine" system (SChM) is possible at the moment of the "miss". Thus, using automated scientific research systems only makes it easier to bring out the personality factor.

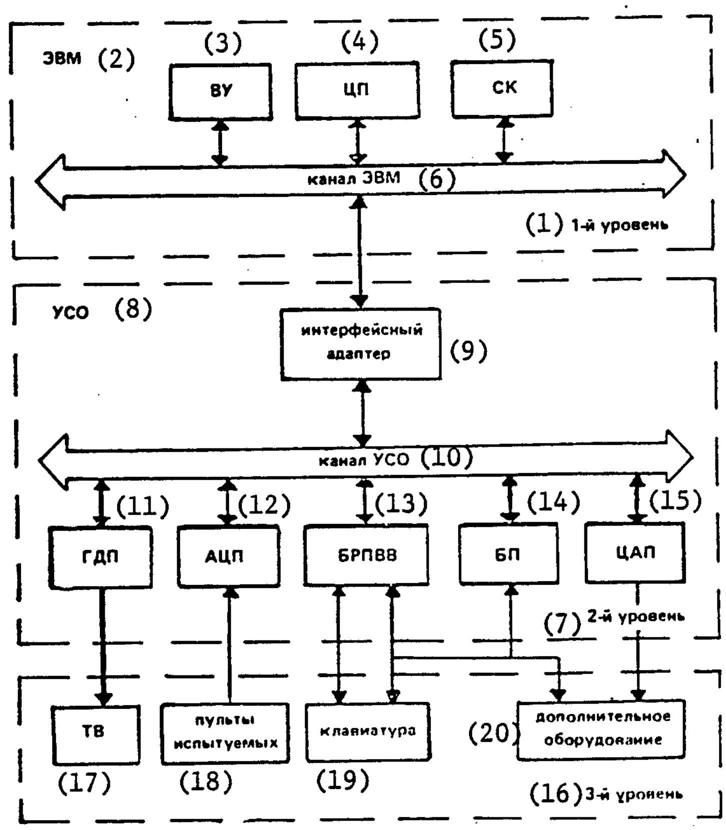
The automated scientific research systems at major scientific research centers are currently being built according to a tri-level scheme [8, 9]. At the top level are powerful computers allowing accumulation, analysis and classification of large streams of experiment information and establishment of data banks. Used at the middle level are minicomputers and complexes of them which operate in the mode of sharing time among the control computer complexes (UVK) on the bottom level. As a rule, the control computer systems at the bottom level are based on microcomputers and are intended for direct control of an experiment and acquisition of raw data. The series control computer systems are based on hardware and software which allow solving the required problems in the complex. Traditionally, the full complement of control computer system hardware is divided into the following groups:
--computer hardware and system peripherals (PU);
--devices for communication with objects (USO);
--devices for operator communication with the control computer system hardware;
--data transmission and storage hardware;
--devices for connecting the control computer systems into multisystems.

The computer hardware and system hardware support all required processing of information and the input/output of control programs and data. Devices for communication with objects switch the computers with the various measurement and test equipment, and allow entering the parameters of the system being controlled into the computer central processor and shaping various control signals. Devices for operator communication with the control computer systems are terminals, key registers, keyboard and other equipment needed to key in, debug and operate control programs. Devices for transmission and complexing are intended for connecting control computer systems into the hierarchical automated scientific research system and contain interfaces for parallel or serial exchange of information.

The general requirements for facilities to automate a psychological and ergonomic experiment, formulated in a number of publications [3, 7, 8], and the experience of the experimental effort underway in the Department of Psychology at Simferopol State University have allowed developing and building a general-purpose, problem-oriented, control computer system based on microcomputers which can serve as the base for organizing various test beds and simulators needed in particular for ergonomic research.

The capabilities of problem-oriented control computer systems are determined by their structure which consists of the following: general principles for building the complex; principles of organizing information processing on the level of the computer central processor; and the organization of the processes

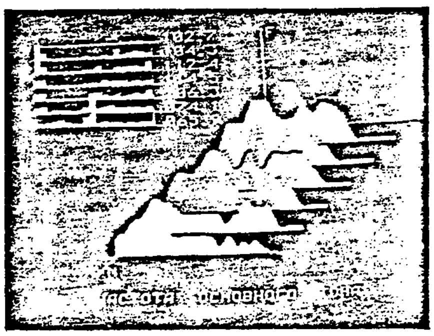
of input/output and exchange between system nodes. Elements in the structure also include the computer units which implement the cited functions and the complex of software enabling system functioning.



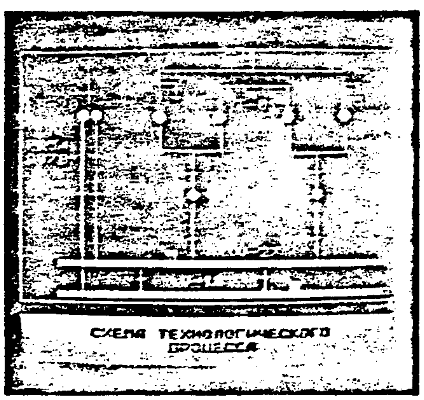
Control Computer System Structure

Key:
1. first level
2. EVM [computer]
3. VU [external devices]
4. TsP [central processor]
5. SK [facilities for complexing]
6. computer channel
7. second level
8. USO [devices for communication with objects]
9. interface adapter
10. object communication device channel
11. GDP [graphic display processor]
12. ATsP [analog-to-digital converter]
13. BRPVV [16-channel block of registers for parallel input/output]
14. BP [32-channel interrupt unit]
15. TsAP [digital-to-analog converter]
16. third level
17. TV [television input]
18. consoles for people being tested
19. keyboard
20. additional equipment

(1)



(2)



(3)

(4)

1. Use of color television graphic display in regular monitoring of variation in time and qualitative indicators of standard actions of the operator being tested

2. Sample of presentation of information to experimenter on screen of color telemonitor for evaluation of functional status of seven operators by features of their speech during performance of joint labor activity [words at bottom of screen: frequency of main tone]

3. Test -- object shown to those being tested during their psychological preparation for activity of operator-process engineer [words at bottom of screen: diagram of technological process]

4. Test -- object for study of properties of attention and effective memory [words at bottom of screen: time - 07 23, errors - 13]

The main subsystem in the control computer complex which determines its problem orientation is the device for communication with an object which is made up entirely of non-series units. Its structure has considerable effect on the efficiency of software developed for experiments since communication with the simulated system is effected through its units.

The main functions of this interface are:
--input of analog control signals from various controls in the simulated man-machine system into the central processor;
--input of signals from bio-electric sensors which reflect the psycho-physiological state of the human operator into the central processor;
--input of signals from switches and knobs set on consoles of operators and the experimenter into the computer;
--input of digital information from measuring equipment;
--generation and output of various stimuli to displays.

Inasmuch as man-machine systems are characterized by a relatively low information throughput capability on the part of the operator, requirements for high speed in the object communication device can be lowered. This allowed simplifying its hardware by transferring certain functions for exchange organization to software.

The device for communication with objects was designed as modular; this allows rapid change in the composition of the subsystems. The basic structure is a printed circuit board which implements the information channel for the device. All modules in the device for communication with objects are connected to the channel at positions fixed for each module. The interface adapter module handles communication between the channels for the computer and the device for communication with objects.

In contrast to more widespread types of series devices for communication with objects (CAMAC, Vektor), the device developed by us has no intermediate controller handling input/output control. All its analog and digital channels are controlled directly by the central processor and have addresses within the computer address range. This organization of the device became possible thanks to the presence of a common channel for information exchange in the microcomputer used, allowed a higher speed of exchange through the channels of the device, and simplified the subroutine for servicing external devices.

Requirements for analog subsystems in the device for communication with objects were determined by the number of channels needed for input of multiparametric information and adequate speed and precision of conversion.

Analog subsystems include a 32-channel analog-to-digital converter (ADC) and an 8-channel digital-to-analog converter (DAC). The ADC handles input voltages with amplitude from -5 to +5 V with an absolute error of 5 mV. Conversion time per channel is 100 microseconds (30 microseconds for the modernized version). The serial principle for processing input signals is used in the device; this allows servicing under program control any number of channels in the given sequence.

The structure of the complex developed by us can be conveniently represented as three levels reflecting the degree of concentration of processes of information processing in the system and their accessibility for software (see the diagram). This allows defining the functions and place of any subsystem included in the control computer complex.

The first and top level of the control computer complex is a microcomputer with a set of basic peripherals and with facilities for complexing intended for expanding system capabilities by connecting additional processors. This level provides for control of all components in the control computer complex, processing of recorded signals and generation of signals shown to those being tested and the experimenter, and also provides the capability of preparing control programs.

The second level in the control computer complex includes the device for interface with objects which performs the functions of a general-purpose adapter between the computer and facilities at the third level. The object communication device contains the subsystems for digital and analog input/output, controllable timer and graphic display processor. All facilities in the second level can be accessed by software and are controlled directly by the central processor in the microcomputer.

Facilities in the third level include devices for operator communication with the man-machine system being simulated and investigated. Composition is governed by the experimenter himself in accordance with the purpose of the experiment.

In developing the structure of the control computer complex and selecting the type of control computers, we considered, on the one hand, the capabilities and cost of the series equipment used, and on the other, the problem orientation of the complex to the class of tasks associated with simulation and study of information-type man-machine systems.

Selected as the base for the first level in the control computer complex was the general-purpose control microcomputer of the Elektronika-60 family (or the Elektronika-NTs80 which has a similar functional organization). The advantages of these micro machines in building a control computer complex are governed primarily by the features of the principles of their design and advanced software [1]. The computers are modular in design. All modules are made as functionally and structurally complete units; a common channel for information exchange enables communication between these units.

The computer channel is a simple high-speed system of communication; unified algorithms for all devices that can be connected to it are used for exchange through the channel. Therefore, external devices (VU) are just as easily accessed by the central processor as the main memory. This considerably reduces software and saves time in information exchange with external devices. Among the advantages of the computer, the simple and convenient instruction set and advanced methods of addressing should be mentioned. The presence of a firmware stack mechanism ensures rapid exchange in the program interrupt mode.

The DAC generates output signals also in the range from -5 to +5 V with an error of 5 mV. It allows connecting plotters, recorders or other analog operating devices to the system. Among the digital subsystems in the device for communication with objects are a 16-channel block of registers for parallel input-output and a 32-channel unit for interrupts (BP). The block of registers is used for connecting to the control computer complex various digital equipment, and also units of the stand operating with binary codes. Each channel in the block of registers supports input/output of information of either bytes (8 binary digits) or two-byte words. The interrupt unit allows entering into the computer signals from various knobs and discrete sensors in the mode of program interruption which allows rapid switching of the computer to the subroutine appropriate for the input channel of this unit. It has a scheme of priorities for arbitration when several requests are made at the same time.

Major components in many man-machine systems are information display facilities (SOI) which provide the operator with basic information on the status of the controlled object and are used in generating the conceptual model of the activity. In recent years in connection with the evolution of computer technology, more and more attention has been paid to integrated information display facilities which allow replacing a number of scale and pointer instruments by a single information display or screen. In many systems, these information display facilities are system terminals which are included in the equipment for particular computers. However, these terminals and the appropriate software are oriented as a rule to a particular class of tasks and do not have the feature of general-purpose allowing use of them in ergonomic research of a broad spectrum.

In connection with this, we developed and built a general-purpose graphic display processor (GDP) which can be connected to standard black-and-white or color television receivers. The graphic display processor can be used to generate various graphic and symbol displays in eight shades of brightness and color on the television screen.

In developing the graphic display processor, we used standard boards for the Elektronika-60 computer, a standard PZ [not further identified] memory module and a microcomputer power supply. This approach allowed making a compact device containing six printed circuit boards made with 155 and 559 series microcircuits.

The graphic display processor belongs to the class of full-graphics terminals and allows displaying an image with any graphic made of 256 x 255 picture elements. The nature of the image is governed by the software. The limits on the speed of transposition of objects on the screen vary with the computer speed. Therefore, maximal rates can be obtained when displaying elements not requiring complex analytic operations in the generation of them.

The graphic display processor capabilities are expanded thanks to the presence of the unit for television input of an image in conventional colors. It can be used to generate information models on the screen containing statistical elements of a complex configuration and moving objects with relatively simple geometry.

The control computer complex software is built on the base of the operating systems with which the Elektronika-60 and Elektronika-NTs80 microcomputers are equipped. Good results are obtained by using the QUASIC operating system oriented to tasks in the controlled experiment [11].

The hardware and software facilities in the first and second levels of the control computer complex implement simulations aimed at studying all basic types of operator activity (in accordance with the well known classification given in [2, pp 27-31]); the facilities are used to build various types of stands and simulators for assessing and improving vocational training of operators. Changing the experimental situation is reduced to writing the appropriate programs for the computer.

Centers for vocational orientation of students, called for by the reform of the school now underway, can also be equipped with this hardware; this will allow testing all students and offering each of them scientifically substantiated recommendations for choosing a vocation.

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8545
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MICROPROCESSORS

Moscow EKONOMICHESKAYA GAZETA in Russian No 40, Oct 85 p 15

[Article by Professor V.A. Myasnikov under the rubric "Computer Literacy School": "Microprocessors: Head of Main Administration of Computer Technology and Management Systems of State Committee of Council of Ministers of USSR for Science and Technology Conducts Second Lesson"]

[Text] The concepts microprocessor, microprocessor technology, and microcomputer are being encountered increasingly frequently.

The computer processor is organized rather complexly. It is an electronic unit consisting of several thousand semiconductor devices (diodes and transistors). For comparison, it should be noted that a simple pocket radio contains seven to 10 transistors, whereas a color television contains 200 to 300. It is no wonder that in the recent past the computer processor was a very large device. Moreover, as recently as 5 to 7 years ago, processors were the most vulnerable place in a computer. Thousands of transistors and other components demanded such a large amount of soldered joints that, even with very strict testing, it was impossible to produce them without error and with an identically high quality.

Modern microelectronics helped solve the problem of designing and constructing miniature and reliable processors. Thanks to the design and construction of special technologies, it became possible to implement both the microprocessor and several other devices in the computer in the form of miniature components called integrated circuits [IC]. As a rule, such circuits are based on transistors.

In the given case, "integration" means the implementation of all the components of circuits using one and the same production operations. This principle seems simple and obvious; however, in practice, accomplishing it requires no small effort.

The circuit is located on a very thin silicon wafer, the dimensions of which are 5 x 5 millimeters. Many thousands of individual components, which have micrometric dimensions, are mounted and interconnected on this "little pin." Finally, the transistors themselves are rather complex devices whose creation necessitates the introduction of additives that are strictly metered with respect to quality and quantity into a monocrystal.

And all of this is subject to the condition that even an insignificant error in the manufacture of the circuit or the failure of even one of its components

makes the device unsuitable for operation. It is impossible to repair such a circuit.

The processing device or processor, which is implemented in the form of an integrated circuit, is also a microprocessor. It is not unusual for large integrated ciruits to be needed in a microprocessor complex. Such large-scale integrated circuits [LSIC] with a high degree of integration are required for accomplishing the rather complex functions of a processor wherein the "components" in the circuit number in the tens of thousands.

It is not always the case that all the functions of a processor should or can be implemented using one LSIC. A complex contains a number of LSICs from which a microprocessor or more complex system is constructed.

Designing ICs and manufactuing the production equipment necessary to produce them are very expensive measures that are economically justified if such circuits are produced in large lots, tens of thousands or even millions.

The computer and its numerous auxiliary devices and various consoles may be located and used in a restricted number of objects: in shops, in organizations, on boats, and sometimes in car bodies. The computer occupies an area countable in square meters or even in tens of square meters. So how can a control device find its way under the hood of a car or inside a television, tape recorder, or washing machine?

Microelectronics, and primarily microprocessors, come to the rescue in this case. Thanks to their small dimensions, they can be used practically everywhere, even in electronic wrist watches. According to the estimates of experts, the number of microprocessor professions presently runs into the tens of thousands. The use of microprocessors has significatly raised the technical level of products, improved their characteristics, and expanded their capabilities. For example, when they are installed in automobile engine control systems, they make it possible to optimize fuel consumption in transient, nonsteady conditions such as during stops, when beginning to move, and when changing speeds, which is very important under modern urban conditions. In the process, the specific fuel consumption rate decreases by 5 to 10 percent, the toxicity of exhaust gases is reduced to approximately one-half, and traffic safety is improved.

Considering the mass nature of their production, the price of a microprocessor IC presently ranges from several rubles to several tens of rubles depending on the complexity of the circuit and the level of development of the technology involved. The power required is also not great, as a rule, a fraction of a watt per circuit. This means that when using one circuit with its power supply from a household electrical network we would pay only 4 kopecks for the electrical power consumed after 3 to 7 thousands of hours of operation. The dimensions of a microprocessor IC equal 50 x 15 x 2 millimeters, and an IC operates for several thousands of hours without failure.

Little more than 10 years have passes from the appearance of the first Soviet microprocessors, and their annual use already numbers in the millions of units.

12794
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UNIFIED SYSTEM COMPUTER (YeS EVM)

Moscow EKONOMICHESKAYA GAZETA in Russian No 49, Dec 85 p 14

[Article by Professor V.A. Myasnikov under the rubric "Computer Literacy School": "Microprocessors: Head of Main Administration of Computer Technology and Management Systems of State Committee of Council of Ministers of USSR for Science and Technology Conducts Fourth Lesson"]

[Text] In this lesson we will examine the class of so-called universal computers, or, as they are also called, general-purpose computers.

Basically, the concept universal computer specifies the area of the use of a given class of computers that are intended to solve problems of arithmetic and logical data processing in the sphere of science and technology and economics and statistics and to manage complex objects, etc. As is common knowledge, requirements for computer technology are dictated by the user.

For example, relatively small volumes of input and output information (source data and results of computations) and a very large amount of computations are typical for scientific-engineering problems solvable on computers. It is frequently necessary to make computations in the so-called real-time mode, for example, during the course of conducting a scientific experiment.

Economic-planning, accounting, and statistics problems bear an entirely different character. These are related to the input into the computer and storage of a very large amount of source data. In itself, their processing demands a comparatively small number of logic and arithmetic operations. When the processing is finished, a large amount of output information is output and printed out. For this reason, the results must be printed in the form of tables, graphs, lists, etc.

At present, the overwhelming majority of universal computers are united in families of types of machines of different productivity but with one computing-process design principle, a single means of communicating with peripherals, and consequently, a common set of peripherals for the entire family. The creation of computer families has been dictated mainly by the striving to unify computer hardware and software and to provide computer compatibility in the framework of families, which makes it possible to use unified hardware and software.

Since 1969, based on the decision of six socialist countries, Bulgaria, Hungary, the German Democratic Republic, Poland, the USSR, and Czechoslovakia (Cuba and Romania later joined with them), the creation of the Unified System (YeS) of Computers was begun. These represent a family (series) of software- and alphabet-compatible machines that are designed on a single design and production base with a single structure, single system of software, and single unified set of peripherals.

In the framework of the program of operations to create the Ryad-1 YeS computer, six models (YeS-1020, YeS-1030, YeS1050, YeS1022, YeS-1033, and YeS1052) and several tens of types of peripherals were designed and constructed in less than 4 years. The purpose of this stage was to design and construct single-machine (uniprocessor) YeS computers and corresponding software for operation in a single-program mode (the completion of one task). A unified engineering policy was worked out for designing and constructing a unified series of computers and peripherals for them.

In 1974, work began on the design and construction of a second line of hardware and software for YeS computers, the Ryad-2 program. Their technical and economic indicators represented an improvement over the Ryad-2 computers. In the second stage, single-machine systems and software were created for operation in a multiprogram mode where one computer simultaneously executes the commands of the same or differenct independent programs. This significantly improved the use factor of the basic devices and created the prerequisite for designing and constructing multimachine (multiprocessor) computer systems for operation in various modes, including batch processing, time-sharing, question-and-answer, and combined modes.

The program of operations to create the Ryad-1 computers provided for designing and constructing seven models of computers and approximately 150 types of peripherals. In this group, the YeS-1035, YeS-1045, YeS-1060, and YeS-1065 with productivities from 0.14 to five millions of commands per second and with a volume of main memory from one to eight megabytes, as well as 30 types of peripherals were designed and constructed in the USSR.

The concept of families of computers has justified itself and will be maintained in the future. Thus, the program for the development of the Ryad-3 YeS computers provides for computers with a discrete productivity scale and with the capability of creating multimachine and multiprocessor computer complexes on their basis that are intended for use in computer networks, territorial and branch centers of the State Network of Computing Centers, Management Information Systems [ASU], and autonomous computing centers [VTs].

The computers included in the Ryad-3 YeS computers must provide the solution of a wide range of scientific-engineering, economic, and special problems both offline and in information processing systems, including those operating in real-time and in a time-sharing mode. Proceeding from the experience of the use of the Unified System and the analysis of trends in the introduction of computer technology into the economy, a computer productivity range from 100,000 to 10 million commands per second has been specified.

In accordance with the resolution of the Council of the Chief Designers of the YeS Computer, the Soviet Union is the developer of the YeS-1046, with a productivity of one million operations per second, and the YeS-1066, with a productivity cf 5.5 million commands per second, both of which belong to the first stage, the implementation of which is already completed.

The possibility of designing and constructing problem- and function-oriented complexes based on the specified computers has been already been achieved in the first stage in the development of the Ryad-3 YeS computers by connecting the following specialized proccessors: matrix text processing, solving boundary value problems, interpreting high-level languages, teleprocessing, etc.

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SYSTEM OF SMALL COMPUTERS (SM EVM)

Moscow EKONOMICHESKAYA GAZETA in Russian No 2, Jan 86 p 9

[Article by Professor V.A. Myasnikov under the rubric "Computer Literacy School": "Microprocessors: Head of Main Administration of Computer Technology and Management Systems of State Committee of Council of Ministers of USSR for Science and Technology Conducts Fifth Lesson"]

[Text] In the previous lesson, we became acquainted with the concept of the universal computer (general-purpose computer). Still, it is not economically feasible to use universal computers where it is not necessary to implement a large number of compuations. It is expedient to use a small computer.

The majority of people imagine the minicomputer as a miniature, small-size computer. This is only partially true. In this case, from an engineering point of view, the concept "mini" means limited and cut down. It is noteworthy that in the minicomputer the computing capabilities of the universal computer are just reduced.

The arithmetic arsenal of the majority of minicomputers is limited by adding and subtracting commands with a fixed decimal point (several models do not even contain a subtraction command). Of course, when necessary, minicomputers can be "forced" to implement complex arithmetic commands. However, this is accomplished either on the program level by shaping corresponding subprograms, which decreases the computer's speed, or by introducing auxiliary hardware, such as an arithmetic expander unit for implementing operations with a "floating" decimal point, etc. In addition, minicomputers are limited with respect to the word length of processable words and, as a rule, contain words with a length of 16, 12, and even 8 binary digits (bits). For universal computers, the word length is 32, 64, and 128 bits. As we will see, the minicomputer is a computer in a limited version.

Like the universal computer, the minicomputer has the capability of executing a program stored in its memory and implementing an algorithm for computations inherent for minicomputers. The acceleration of scientific-engineering progress has dictated the necessity of the mass introduction of small computers.

Modern technologies are so complex that it has become urgently necessary to manage the course of processes in coordination with both external and internal factors: the quality of raw feedstock, materials, equipment operating modes, and even climate conditions. Usual (relay) automation means cannot handle these tasks. What is needed are means of testing and management that can analyze the aggregate production situation: the presence of feedstock and materials of a specified quality in warehouses, the allowance for the

capabilities of equipment and the production process as a whole, and the coordination of these capabilities with a production program to provide the necessary management actions. Also, requirements for operational testing of the safe course of processes and safety engineering have also grown.

It is no accident that the first minicomputer was designed and constructed to manage an atomic reactor. A computer with program control that makes an allowance for a set of varied relations of the type "and what if", "and if not, what then", etc., appeared in the context of the complexities of the course of the thermonuclear process.

At the same time, the economic expediency of an engineering solution has a most important meaning. Everything that made the universal computer unfeasible for the specific engineering task of management was removed from it. Reducing the arithmetic device and the length of the computer's word length made it possible to sharply reduce the price, physical dimensions, and required power; simplify maintenance; and improve operational reliability.

The first and principal area of the use of the minicomputer is that of managing production equipment, lines, and processes (process control management automation systems [ASUTP]). However, as we have already said, the computing capabilities of minicomputers may be implemented with only an insignificant increase in cost, but at the expense of both software and hardware. Consequently, the area of their use has not been limited to ASUTP.

The last few years have been characterized by an increase in the production of minicomputers both in our country and abroad. Attesting to this is the fact that the total number of minicomputers has been increasing annually two- to 2.5-fold. In the process, their development has also progressed in a qualitative respect.

Besides being used in plant management automation systems [ASUP] and ASUTP, small computers have also found wide use in text processing, bookkeeping accounting, teleprocessing and computer networks, distributed data processing, and research systems, etc. It is characteristic that all of these areas of use are also related to production management.

Based on the variety of the areas in which minicomputers are used and the modes in which they must work, as well as in accordance with the nature of the process being controlled, a large number of minicomputers have appeared that are distinguished by their productivity as well as by their volume of peripheral equipment. Obviously, managing the production process and technology necessitates processing information about their status that is incoming from sensors, and devices for input-output from documents are needed in order to process texts and bookkeeping calculations, etc. In this context, the number of computers themselves and peripheral equipment is very great. It has become as urgent to unite them into series of devices that are compatible among one another as it was in the case of the YeS computers.

A family of small computers (SM EVM) is being developed in cooperation with the member-nations of the Council for Mutual Economic Assistance in the framework of works being conducted by the intergovernmental commission on computer technology.

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